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(54) Concrete floor slab

(57) Apparatus for forming the edge of a concrete floor slab, the apparatus comprises a divider plate (13) formed with a plurality of apertures (15), dowels (16) for engaging through the apertures and sleeves (17) for applying to the dowels, in which the divider plate is provided with means, in use, to adjust the height thereof above the ground.

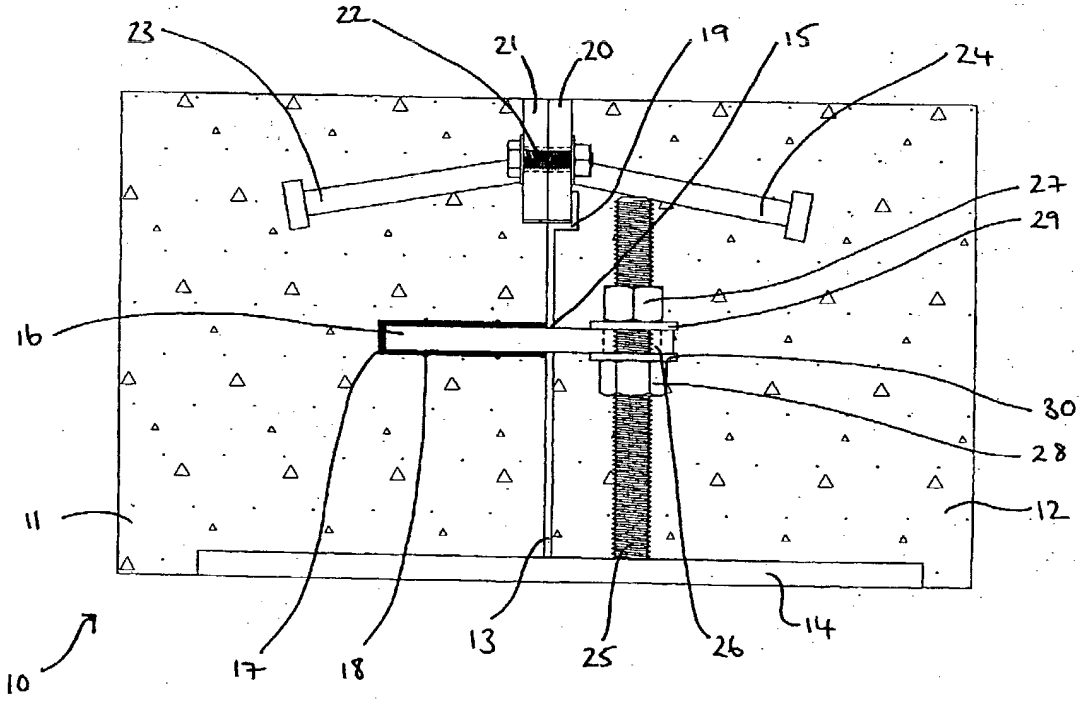

Fig 1

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Description

[0001] This invention relates to the forming of concrete floor slabs, particularly the forming of the edges of the slabs, and to providing improved means for load transfer between adjacent slabs.

[0002] It is well known that concrete floor slabs are cast in place inside a formwork commonly constructed from timber. The formwork provides an edge and defines a space in which to cast the concrete; it does not, however, provide support or protection during the casting or curing process or throughout the lifetime of the slab.

[0003] When casting slabs using the known formwork it is difficult to arrange the formwork such that the upper edge thereof coincides with the intended level of the upper surface of the slab. Packing pieces such as wedges are used in order to adjust the height of the formwork in which to cast the slabs.

[0004] Once cast, concrete slabs are prone to shrinkage during curing which causes the edges of the slabs to separate and expose the upper edge or arris of each individual slab to damage from loads, such as from lorries, passing across the joint.

[0005] Individual slabs often support heavy loads passing from one slab to another and therefore require a method of load transfer between adjacent slabs in order to prevent breakdown of the joint between adjacent slabs caused by stresses induced by such loads. Typically round or square steel rods, commonly known as dowels, are embedded in the concrete to extend at 90 degrees across the formed joint and connect the slabs together in order to transfer a load from one slab, across the joint, to the adjacent slab. However, when the slab shrinks during curing, the dowels embedded in the concrete themselves create stresses in the slabs due to differential shrinkage between adjacent bays of concrete, this becoming a further cause of cracks in the slabs particularly at corners. In any event, a load transferred by a dowel results in concentrated zones of stress immediately above the dowel, with consequential risk of edge cracks occurring. WO99/31329 proposes, as a solution to this problem, the use of plate dowels and sleeves, called "blockout sheaths", to spread the loads more effectively and to provide for relative movement between the dowels and the concrete. However, the problems of formwork height and edge damage to the cured slabs remain.

[0006] It is therefore an object of this invention to provide height-adjustable apparatus for forming the edges of concrete floor slabs, to provide means for load transfer between adjacent slabs and preferably to protect the arris of the slab after casting of the concrete.

[0007] In one aspect the invention provides apparatus for forming the edge of a concrete floor slab, the apparatus comprising a divider plate formed with a plurality of apertures, dowels for engaging through the apertures and sleeves for applying to the dowels, in which the divider plate is provided with means, in use, to adjust the height thereof above the ground.

[0008] The divider plate is preferably formed from metal and is intended to be left in place between slabs cast on each side thereof. The divider plate may be supported above ground level on longitudinally spaced apart feet, the feet being operatively connected to the height-adjustment means.

[0009] The apertures formed in the divider plate may be any shape and size in order to receive the dowels, which may be round, square, or formed as flat plates, for example rectangular or trapezoidal plates. The dowels may comprise means for receiving and securing the height-adjustment means, or the height-adjustment means may be attached direct to the divider plate. The sleeves for applying to the dowels will correspond internally with the shape of the dowels used, in order to provide relative two-way horizontal sliding movement and a tight fit vertically. The sleeves are preferably formed from a plastics material to reduce the coefficient of friction between the dowels and sleeves The sleeves may be formed with lug or ridge members which allows them to be retained in place within the slabs cast.

[0010] The means for adjusting the height of the divider plate above ground level may comprise a leg and means for attachment of the leg to the divider plate at a selected height. The leg may be attached direct to the divider plate by a lock means which is passed through a vertical slot formed either in the leg or the plate to provide for height adjustment. However, in another embodiment, the leg may be screw threaded and can either be threaded or passed through the dowel or through a collar attached to the dowel with means for altering the position of the dowel along the length of the leg. Where the leg is threadedly engaged, such means may comprise a slot or socket to receive a suitable driver to rotate the leg. Where the leg is passed through, such means may comprise adjustment nuts and suitable washers. In either case, the effect is to move the dowel vertically along the leg in order to adjust the height of the apparatus through the engagement of the dowel with the divider plate.

[0011] The apparatus may further comprise edge rails which are preferably supportable by the divider plate to provide protection to the arris of the cast slabs. The edge rails may further comprise anchor means which become embedded in the concrete during curing and which fix the edge rails in position. The edge rails of adjoining slabs are preferably attached together with yieldable fixings wherein, as shrinking occurs during the curing process and the edge rails of adjacent slabs are drawn apart, the fixings yield to allow for the movement. The yieldable fixing may comprise low-tensile bolts, for example formed from nylon, the threads of which will become stripped under shrinkage forces. However, at least some of the bolts may be steel to hold the edge rails firmly together until after a first slab has been cast on one side of the apparatus, the nuts then being removed

from the other side before the second slab is cast. The fixings for the edge rails are preferably located in holes formed through the rails, the fixings carrying a longitudinally-split resilient steel or plastics sleeve to take up any free space between the fixings or the shanks thereof and the holes, to ensure that adjacent rails are accurately placed in position. Optionally, the height-adjustment means is attached to the edge rails or to the anchor means thereof.

[0012] Apparatus according to the invention can be used to form prefabricated four-way intersections, three-way "T" intersections, corner units and loading dock units.

[0013] Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which

Figure 1 is a cross section of one form of apparatus according to the invention forming a joint between two adjacent concrete slabs;

Figure 2 is a perspective view of parts of the apparatus of Figure 1;

Figure 3 is a cross section of the apparatus in Figure 1 once the slabs have cured, shrinkage has taken place and the joint opened;

Figure 4 is a perspective view of an alternative form of apparatus including trapezoidal plate dowels according to the invention;

Figure 5 is a perspective view of the apparatus shown in Figure 4 including diamond dowels;

Figure 6 is a cross section showing the apparatus of Figure 4 in place between two cured slabs of concrete; and

Figure 7 shows a general perspective view of apparatus according to the invention when arranged to form a four-way intersection.

[0014] With reference to Figures 1 and 2, the apparatus shown generally at 10 is embedded in concrete slabs 11 and 12. The apparatus is pre-assembled and is put in place before the concrete slabs are cast. A divider plate 13 is disposed at right angles across feet 14 which are positioned on the ground. The divider plate 13 has apertures 15 which receive trapezoidal dowel plates 16, the median length of the dowel plates corresponding with the length of the apertures so that approximately half of each dowel plate protrudes through its respective aperture, the other half (having the longer edge) remaining protruding from the insertion side of the divider plate. Once the dowel plate 16 has been inserted through the aperture of the divider plate 13, a sleeve 17 formed with external ridges 18 is applied over the portion of the dowel plate which protrudes from the aperture and has the shorter edge. The upper end region of the divider plate 13 is provided with a seating 19 which supports an edge rail 20 for the slab 12 which is itself attached to an edge rail 21 for the adjacent slab 11 by low-tensile bolts 22. Each edge rail is formed with anchors 23, 24 which become embedded into the concrete during the casting process. The apparatus is supported on height adjustable legs 25 which are attached to respective feet 14 and inserted through holes 26 in the dowel plates 16 and secured therein by nuts 27, 28 and washers 29, 30. In use, the height of the divider plate can be adjusted by the movement of the dowel plate 16 up or down the leg 25, by manipulation of the nuts 27, 28 until the divider plate is level and with the upper edges of the rails 20, 21 at the desired height. Further apparatus can then be attached at the ends and height-adjusted; preferably, the edge rails are slightly longitudinally offset to provide a lap joint where adjacent divider plates meet end to end.

[0015] Once the pre-assembled apparatus has been put in place the slabs are cast and left to cure. During the curing process the slabs shrink and cause the edges of the slabs to become separated from one another.

[0016] Figure 3 shows slabs 11, 12 which have become separated due to shrinkage leaving a gap 31. The bolt 22 has sheared to allow the separation of the adjacent slabs and anchors 23, 24 which are embedded in the set concrete, secure the respective edge rails 21, 20 to the arrises of slabs 11, 12 to protect them. In addition, to reduce the stress on the individual slabs caused by shrinkage, the dowel plate 16, which is attached to leg 25, is movable within the sleeve 17 in two horizontal directions but not vertically.

[0017] With reference to Figure 4, Figure 5 and Figure 6, a divider plate 41, formed with an upturned lower edge 42 for strengthening purposes, is supported on detachable legs 43 attached to ground-engaging feet 44. The divider plate 41 carries a series of vertical slots 45, the legs 43 and feet 44 being attached to selected slots with bolts 46 and nuts 47, shown as wing-nuts 48 in Figure 5. The height of the divider plate relative to the ground may be adjusted by virtue of relative movement between the slot 45 and the bolts 46.

[0018] As with the apparatus shown in Figures 1 to 3, trapezoidal dowel plates 49, as in Figure 4, are passed through horizontal slots formed in the divider plate and sleeves 50 are applied from the other side of the divider plate, over the protruding portion of the dowel plates. Optionally, the dowel plates could be other shapes, for example rectangular or square, in the latter case being inserted through the divider plate such that opposite corners extend from the divider plate as triangular forms, as in Figure 5.

[0019] The upper edge of the divider plate carries edge rails 51, 52, secured together by bolts 53 and nuts 54. The bolts, formed from nylon, carry a longitudinally-split sleeving 55 around the shank thereof to ensure

that, with the rails 51 and 52 secured together, there is no possibility of relative movement between them which will result in the upper edges of the rails becoming misaligned with each other. Anchor pins 56, 57 are welded to the respective rails 51, 52 at intervals.

[0020] With particular reference to Figure 5, concrete slabs 58, 59 have been cast on respective sides of the divider plate 41 and the concrete has cured. In the process, the concrete has shrunk and the edge rails 51, 52, secured to the respective slabs by the anchor pins 56, 57, have been drawn apart by shearing of the threads of the bolt 53 in the nut 54. The dowels 49 have withdrawn slightly from the sleeves 50 as the slabs move apart. As with the apparatus shown in Figures 1 to 3, the edge rails 51, 52 could be longitudinally offset so that their ends, instead of being flush as shown in Figure 4, are staggered so that, when placed in end-to-end relationship with another divider plate and edge rails, the edge rails form a lap joint.

[0021] With reference to Figure 7, four sets 71 to 74 of apparatus are shown intersecting orthogonally at a prefabricated joint 75 between four slabs. The four limbs of the joint 75 which are joined to respective divider plates with the edge rails forming lap joints 76, 77, 78, 79 can move to allow for shrinkage when each slab is cast. Purely for illustrative purposes the respective sets have different arrangements of dowel plates and height-adjustment means: sets 71 and 74 have trapezoidal dowel plates and sleeves 80, 81 and sets 72 and 73 have diamond-shaped dowel plates and sleeves 82, 83. Height-adjustment of set 71 is provided by means of rods 84 welded to concrete anchor pins 85 and supported by legs 86 welded at the appropriate distance to achieve the desired height. Set 73 has screw-threaded legs 87 engaged through holes in the plates 82 by nuts 88 and washers 89. Set 74 has a separate height-adjustment jack arrangement consisting of a base 90 and leg 91 slidingly carrying an arm 92 temporarily attached to the edge rail and movable up or down by turning screw-threaded rod 93 via nut 94, captive nut 95 being welded to the arm 92 via slider 96. The jack is used on the side remote from the first cast slab and removed before the second slab is cast.

Claims

1. Apparatus for forming the edge of a concrete floor slab, the apparatus comprising a divider plate formed with a plurality of apertures, dowels for engaging through the apertures and sleeves for applying to the dowels, in which the divider plate is provided with means, in use, to adjust the height thereof above the ground.

2. Apparatus according to claim 1, in which the divider plate is formed from metal

3. Apparatus according to claim 1 or claim 2 in which the divider plate is supported above ground level on longitudinally spaced apart feet, the feet being operatively connected to the height-adjustment means.

4. Apparatus according to any preceding claim, in which the dowels are formed as flat plates.

5. Apparatus according to any preceding claim, in which the dowels comprise means for receiving and securing the height-adjustment means.

6. Apparatus according to any of claims 1 to 4, in which the height-adjustment means is attached direct to the divider plate.

7. Apparatus according to any preceding claim, in which the means for adjusting the height of the divider plate comprises a leg and means for attachment of the leg to the divider plate at a selected height.

8. Apparatus according to claim 7, in which the leg is screw threaded.

9. Apparatus according to claim 8, in which the leg is passed through an aperture formed in the dowel and is provided with dowel-engaging adjustment nuts.

10. Apparatus according to claim 7, in which the leg is attached direct to the divider plate by a lock means in operative engagement with an adjustment slot.

11. Apparatus according to any preceding claim further comprising edge rails supportable by the divider plate.

12. Apparatus according to claim 11, in which the edge rails further comprise anchor means for embedding in the concrete.

13. Apparatus according to claim 11 or claim 12, in which the edge rails of adjoining slabs are attached together with a yieldable fixing.

14. Apparatus according to claim 13, in which the yieldable fixing comprises low-tensile bolts.

15. Apparatus according to claim 13 or claim 14, in which the fixings are located in holes formed through the rails, the fixings carrying a longitudinally-split resilient steel or plastics sleeve.

16. Apparatus according to any of claims 11 to 15 as dependent on any of claims 1 to 4, in which the height-adjustment means is attached to the edge

rails or to the anchor means thereof.

17. Apparatus according to any preceding claim when prefabricated to form a four-way, three-way or corner intersection.

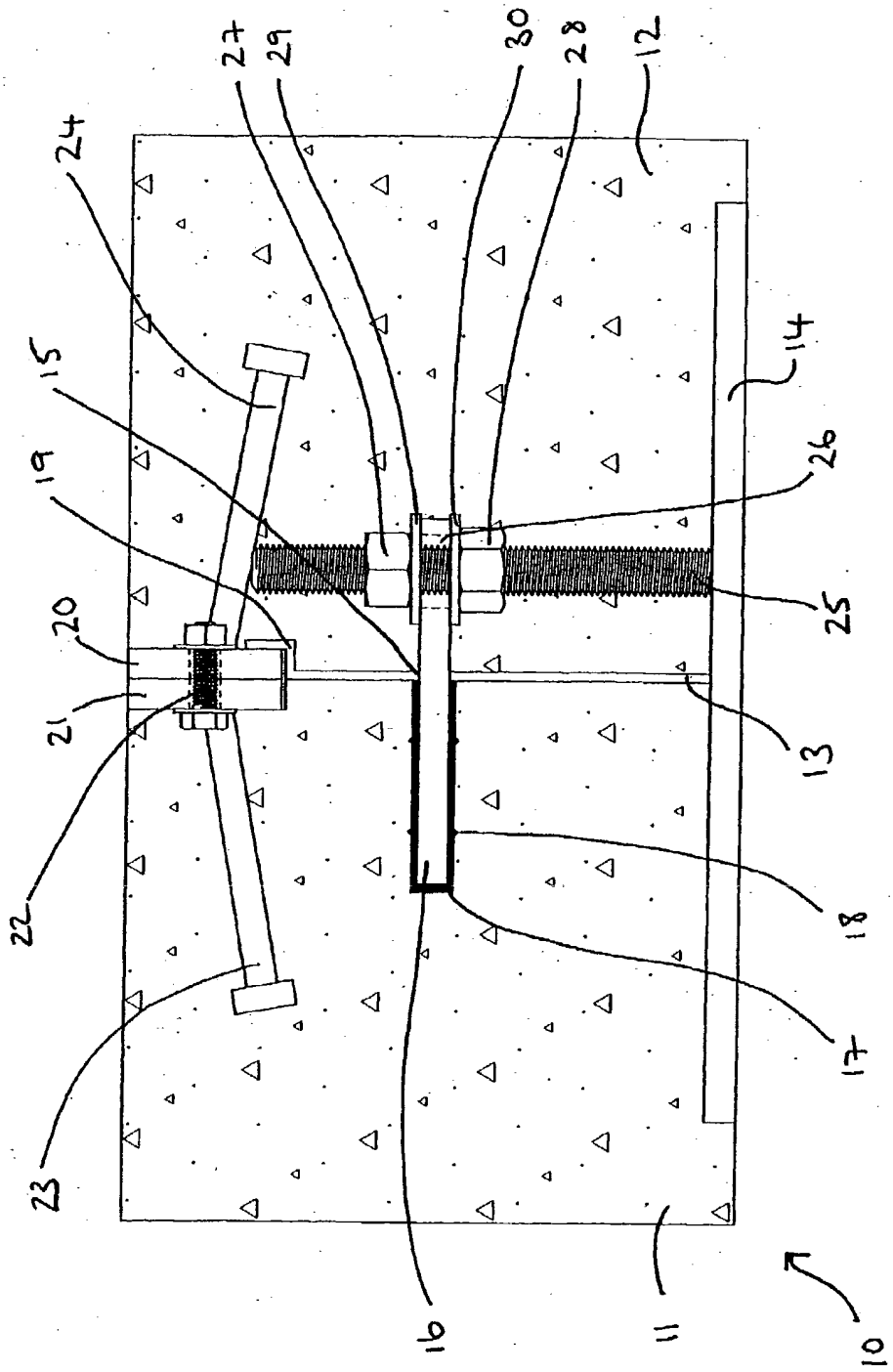


FIG 1

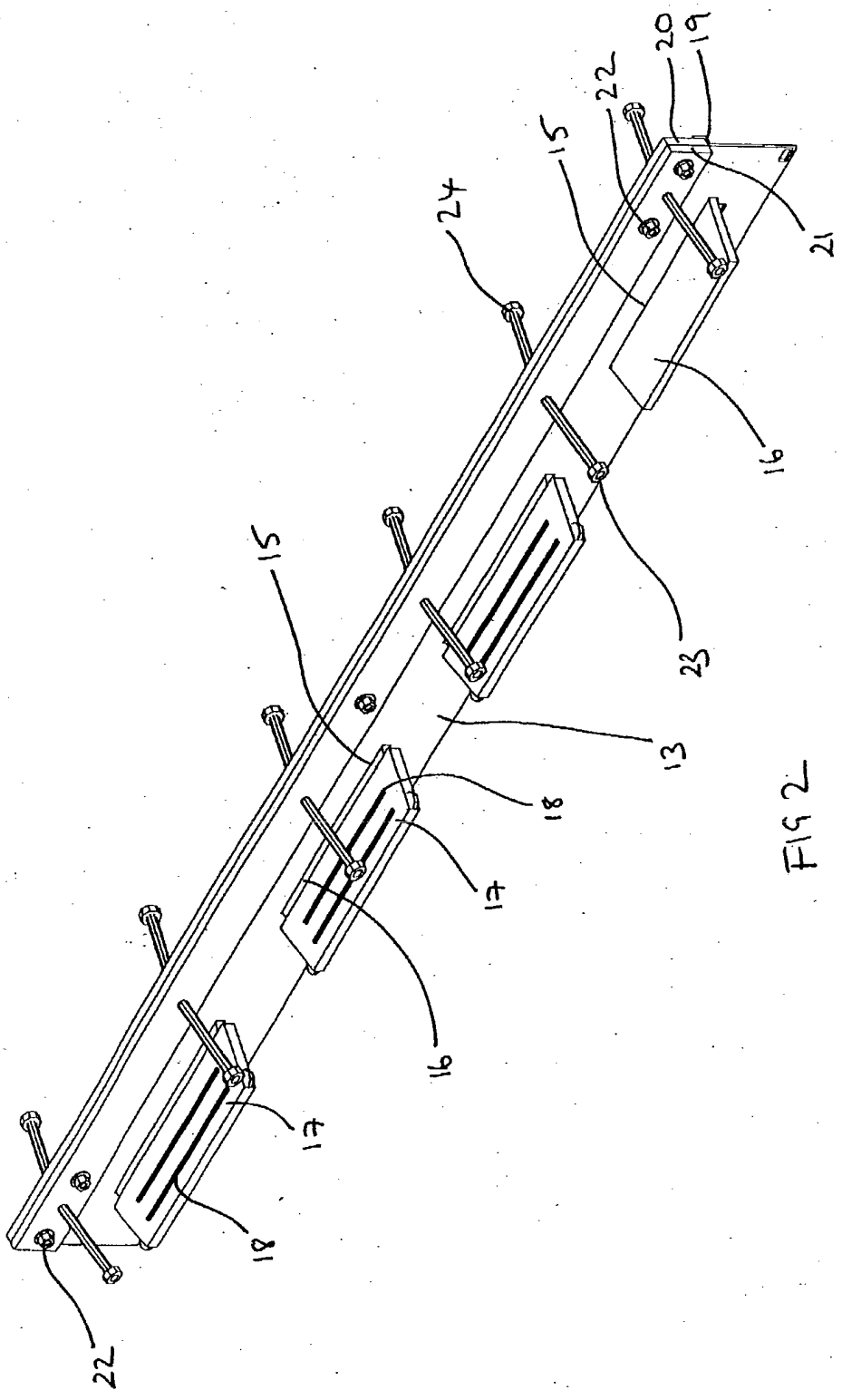
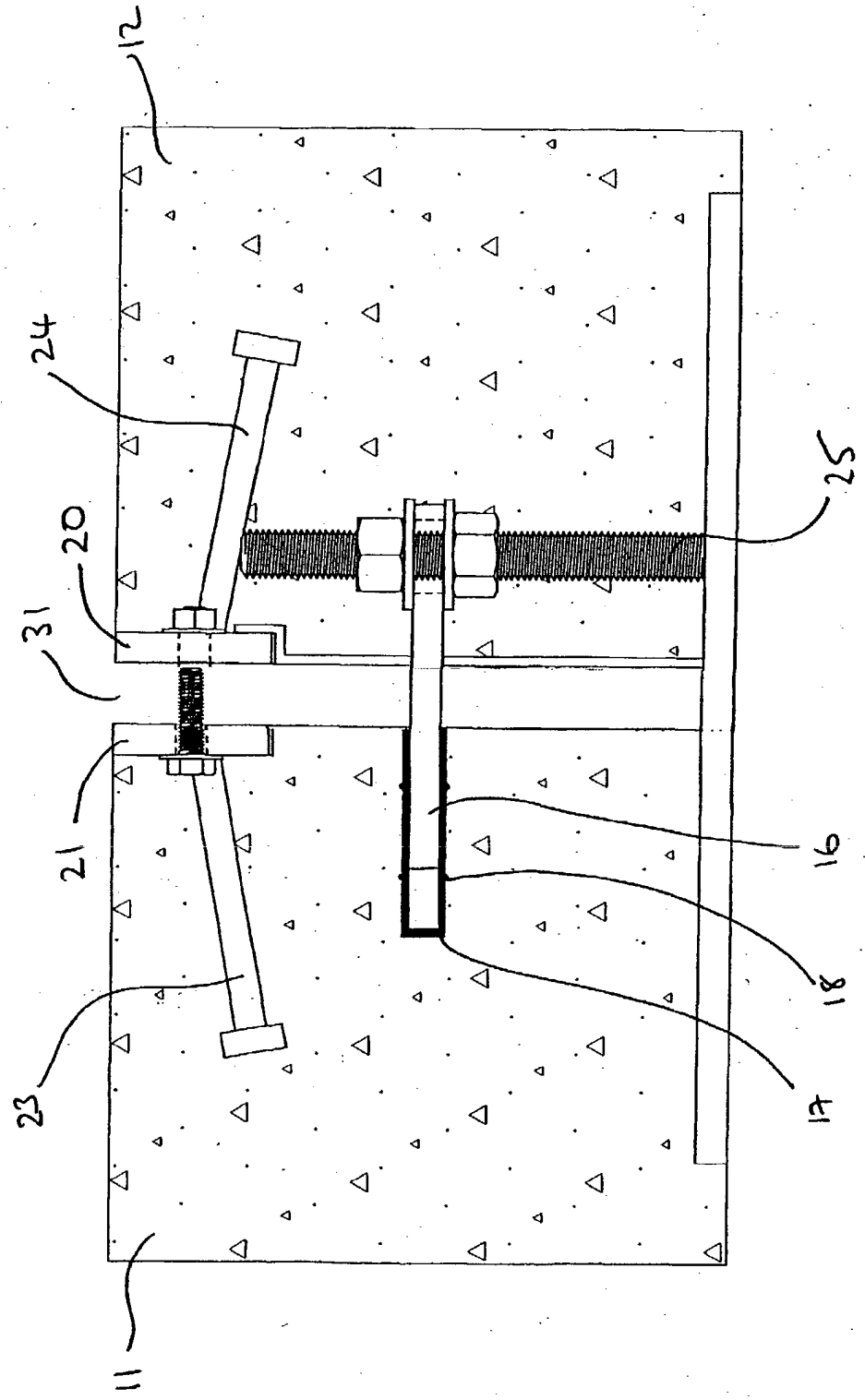


FIG 2



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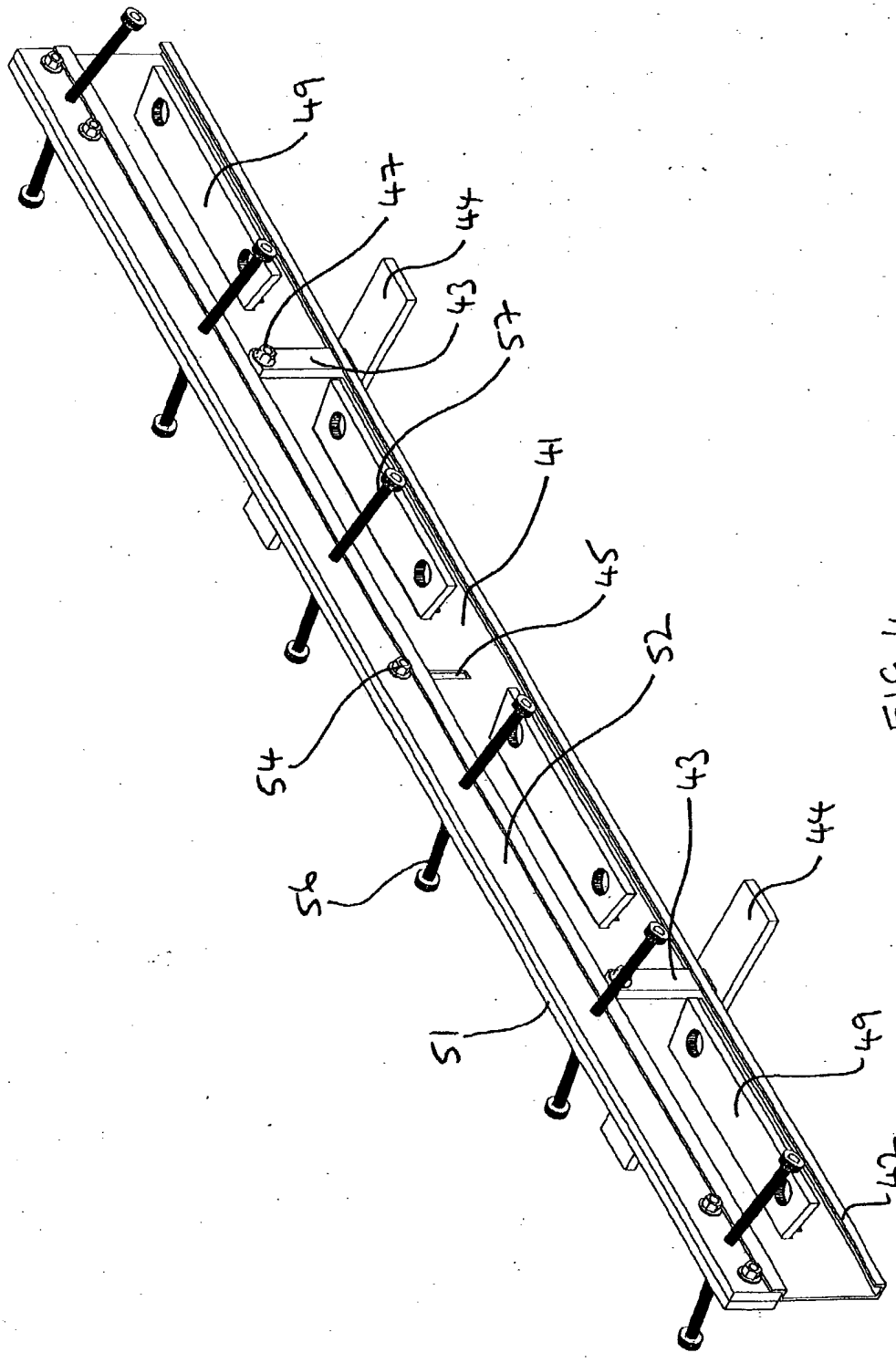
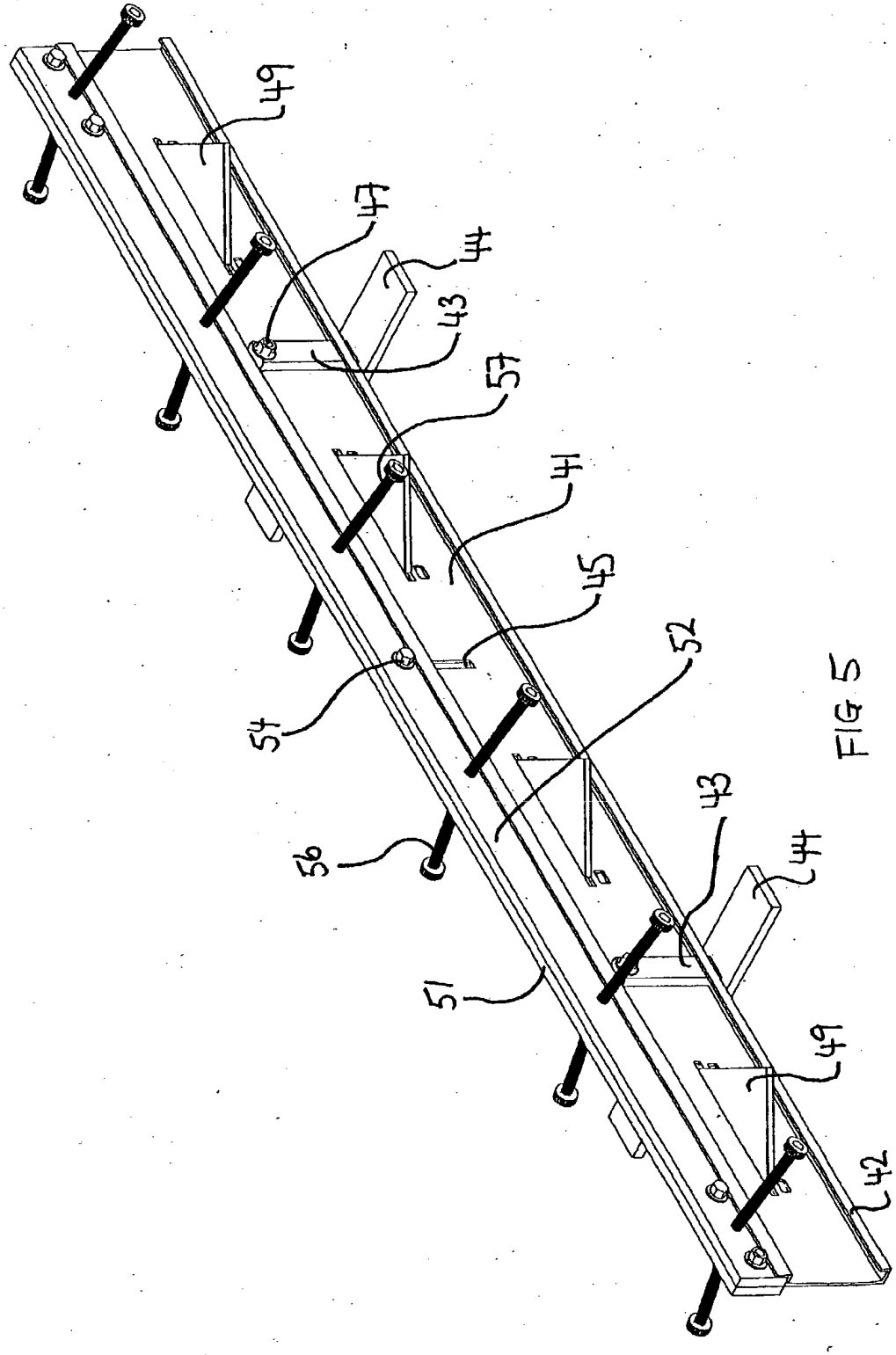


FIG 4



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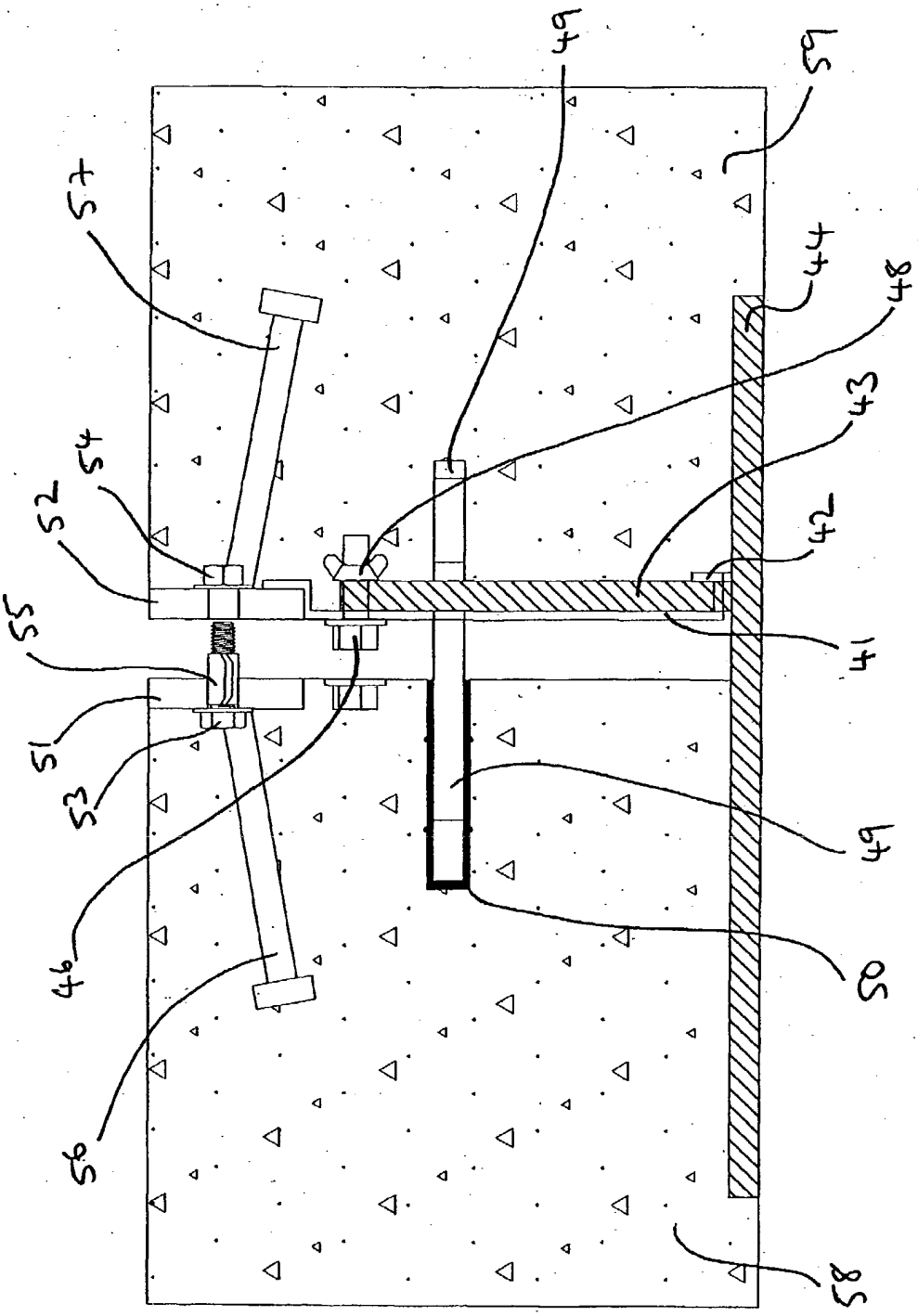

FIG 6

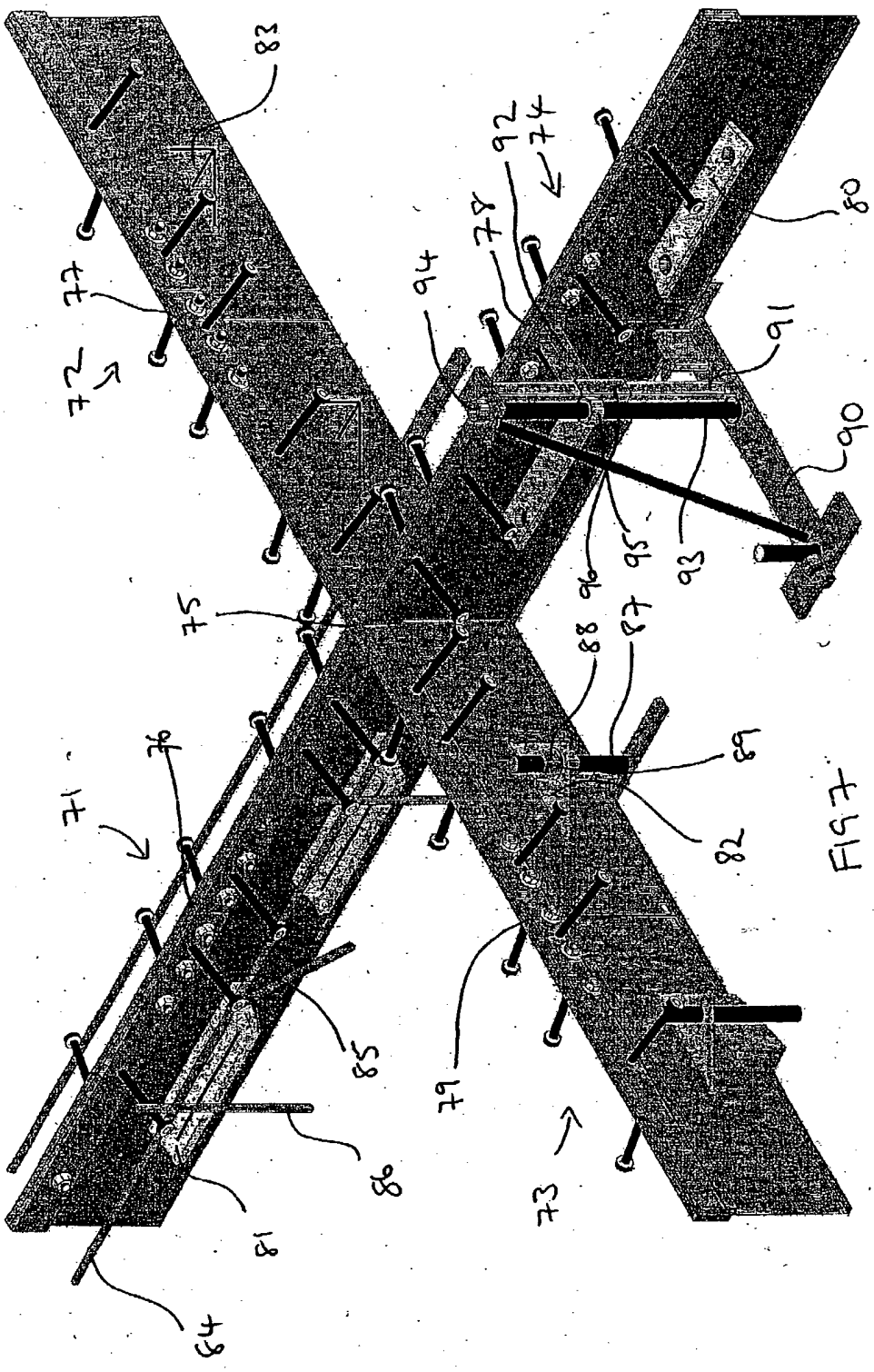
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Fig 7

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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 5115

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	DE 201 10 547 U (K H WIEGRINK GMBH) 4 October 2001 (2001-10-04) * page 3, line 4 - page 6, line 7; figure 4 *	1-3,5-8, 10-17 4	E01C11/14
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E01C
E04F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 November 2003	Movadat, R

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